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trary sides, there is no tendency to mix together; but the division between the two, called the 'cold wall,' is nearly a vertical plane. This is the whole mystery of the Gulf Stream and of the cold wall.

The level of the Mediterranean Sea at Marseilles is undoubtedly a little lower than that of the Strait of Gibraltar and of the ocean generally adjacent to the north-western coast of Africa; so that the latter is about on a level with the western extreme of the Gulf of Mexico, there being a little down-grade across to the West Indies, and then a little ascending grade to the coast of Mexico to check the westward motion, and to deflect the current around toward the north. The difference, therefore, between the ocean-level at New York and Brest is probably about five feet.

There is another theory, the wind-theory, which is thought by some to explain satisfactorily all the currents of the ocean. It may be well to examine a little here the claims of this theory, and especially to consider whether it is adequate to explain the recently observed differences of sea-level. The westward component of the trade-winds, by this theory, raises the level of the Gulf of Mexico, and depresses the sea-level on the north-west coast of Africa as much; and the eastward and north-eastward motion of the air in the middle latitudes drives the water toward the coast of Europe, and so causes a depression of the sea-level on the American coast, and a raising of it on the coast of Europe. It is readily seen that this would give precisely the same system of circulation, and tend to cause the same differences of level between the Gulf of Mexico and New York harbor, and between the harbors of Brest and Marseilles, as the other theory. But it is well known that ordinary winds have very little effect in changing sea-level, except in very shallow water.

According to the Report of the chief of engineers (1876, part iii. p. 76), by the mean of all observations, the difference of mean level of Lake Ontario, at either end, with north-east, east, and south-east winds, and with south-west, west, and north-west winds, is only 0.05 of a foot, and hence the average effect of either class of winds on the surface level is less than one-third of an inch.

Again, if the trade-winds cause a raising of the sea-level in the Gulf of Mexico by a half-metre, they must depress the sea-level on the Pacific coast of Mexico about the same amount, and so there would be a difference of level of about one metre on the two sides. But by the levellings for the Nicaragua ship-canal, the elevation of the surface of Lake Nicaragua was found to be exactly 107 feet above mean tide of either ocean. Hence the trade-winds have no sensible effect in changing sea-level.

Furthermore, if the trade-winds can have so great an effect as is claimed for them, then the still stronger westerly winds, which usually prevail in the middle latitudes of the North Atlantic, should change the difference of sea-level between New York and Brest at least as much; and if so, there would have to be a considerable annual inequality in the height of sea-level; for the westerly winds are much more prevalent, and blow very much more strongly during the winter than during the summer season. There ought, therefore, to be a change of the height of sea level of more than one foot, higher in winter and lower in summer, on the east side of the Atlantic, and the reverse on the other. But no such inequality is observed on either side. Mean sea-level is two or more inches higher, on both sides, in summer than in

winter, which is evidently due to the difference of temperature of the sea-water in the two seasons, and there is no apparent effect whatever arising from an increase of the strength of the winds. The only inference from this is that the strongest winds have no sensible effect.

A continuous wind, for some time in any direction, evidently causes mere surface currents of considerable velocity; but if they could even explain the strong and deep flowing currents, such as the Gulf Stream, it is evident, from what is shown above, that they cannot account for the great differences of sea-level which have been shown to exist by recent levellings.

WM. FERREL.

Washington, Jan. 18.

Oil on troubled waters.

I do not know much about the sea, and so perhaps you will wonder the less at my expressing incredulity with reference to the reports of the extraordinary effect of 'oil on troubled waters,' to which you seem to give unqualified assent in your notes and comments of Jan. 15.

It is indeed remarkable that seamen should have overlooked this important aid to navigation, if, as you declare, its efficiency in calming the waves is as obvious as the use of the rudder in shaping a new course; for sailors are not usually slow to adopt notions favorable to the existence of prodigies and marvels.

But, if the newspaper accounts of the matter are to be believed, it strikes me that the hydrographic office has quite outdone every other politico-scientific bureau in the propagation of startling generalizations from very flimsy details. For example: one of its witnesses testifies that in 1863, when off Sydney Head, he encountered a terrific gale, followed by a tremendous sea, in which his ship was making water, and was in danger of wreck, and that he at first tried oil upon the waves by 'jerk[ing] it out' over the side of the vessel, through a hole in the cork of a bottle; but finding that when employed in this way it blew about the stem of the ship, and not into the sea, he made use of 'the oil-bag,' into which he put about half a gallon, tying the neck tight, and towing it astern. After a short time, he says, "the effect was wonderful; for what was a very heavy-running and dangerous sea was reduced, by the use of the oil, into what a seaman would call 'blind rollers,' quite harmless to a ship." He asserts that in this manner he ran his half-sinking vessel from Sydney Head to Port Stephens, a distance of sixty-eight miles, in eight hours and a half, on a consumption of two gallons and a half of oil, although he considers that his way of using it was wasteful. His subsequent experiences convinced him that a ship could run in any sea with safety for twenty-four hours on a consumption of five gallons of oil.

It is hardly surprising, that, as soon as the hydrographic office began spreading such sailors' yarns as this, other captains should have felt the necessity of keeping abreast of the times in nautical science by publishing their similar experiences. Accordingly the skipper of the schooner J. B. Atkinson announces, that, on the 25th and 26th of December, his vessel was saved from utter destruction off Cape Hatteras by bags of oil, which he also towed astern; and still later, the captain of the steamer Lucy P. Miller, running between Philadelphia and Nassau, writes to

the chief hydrographic officer that he, too, was in imminent danger in a heavy gale on the 26th of December, but that, having read what the hydrographic office had said about using oil, he "placed a bag in each closet forward, and let her go south-south-east," the effect of which was that he shipped no more water.

After all this, I should not wonder if some Jack tar, a little more imaginative than the rest, should outrun all competitors by reporting to the hydrographic office that he had quelled the raging deep merely by carrying a bottle or two of oil in the ship's locker; just as Hahnemann finally found that it was not necessary actually to take his medicine, but that, if the patient only smelled of the phial in which it was contained, it accomplished the same result.

Now, I should seriously like to know whether there is any more credible evidence that oil has a quieting influence upon the ocean than the kind of trash the newspapers are publishing as coming from the hydrographic office.

C. F. Cox.

New York, Jan. 18.

[Our correspondent assumes a very grave responsibility in trying to throw discredit on the efforts of the hydrographic office to render less dangerous the very hazardous vocation of the sailor. The efficacy of the use of oil to smooth the rough waters has been known for centuries, and the seamen of all countries have been in the habit of resorting to it when the necessity has arisen, although, for the reasons given below, not as freely as would be desirable. The evidence accumulated by the hydrographic office, through its branches in the seaboard cities, is the result of the first systematic attempt ever made by any government to collect such information, and to disseminate it, in the widest possible manner, among the class most interested. Many seamen have used it with success; and most, having heard of its value ever since boyhood, have always intended to use it on occasion. It must be borne in mind, however, that there is much to be done on board a ship undergoing all the vicissitudes incident to a gale of wind; and, unless the captain has had previous experience, he is not likely to think of experimenting when there is so much to do which he knows to be necessary. Seamen, also, though given to the telling of 'yarns,' are slow to believe them, a very harsh and trying experience making this class most incredulous and conservative.]

The life-saving services of this country and Great Britain have made experiments with a view to demonstrating the usefulness of oil in quelling the surf. The results, however, have been unsatisfactory; yet this investigation led them incidentally into the subject of its usefulness off shore with most satisfactory results. The report to the superintendent of the U. S. life-saving service in 1883, of a committee appointed to examine this matter, states in conclusion, "The majority of the printed statements herewith, assuming them to be authentic, together with all verbal statements made by mariners who have used it, furnish conclusive evidence that in deep water oil has a calming effect upon a rough sea."

In an article published in the *Nineteenth century* for April, 1882, Mr. C. F. Gordon Cumming states that "it is now many years since I first endeavored to call public attention to the simple precaution." "Though the casting of oil on troubled waters has been so persistently regarded merely as a poetical

figure of speech, notes of its actual use have occasionally appeared in books of travel;" and, again, "It has been reserved for the nineteenth century to find the practical application of the observations made by Pliny eighteen hundred years ago." The correspondent's confessed want of knowledge of the sea leads him very properly to make inquiries in regard to its 'prodigies and marvels;' but his sympathy should restrain him from decrying any attempt to benefit a class which, on the whole, gets a very small share of the substantial comforts of life.—ED.]

The following is a letter received at the Boston branch of the hydrographic office:—

On Nov. 28, 1885, I left Boston for London, deep with general cargo, and cattle and sheep on the upper deck. At 8.30 P.M. of Dec. 4 we were caught in a heavy storm at W. N. W., bar. 29.20. The first hour of the storm no canvass could stand it. In lat. 44° 38' and long. 48° 28' W., ship running under bare poles, the sea was then so high and dangerous. I resolved to try the use of oil, having had it brought to my notice by information on your chart. I got two common gunny-bags and a good wad of oakum wrung out in paint-oil, and hung over each quarter, just dipping in the water, also one over by the scuppers in the midships. At 10 P.M. I got the lower topsail set, and continued to run until noon next day. By the racing of the engines my engineer reported to me that he could not run much longer, as the packing of the gland of the high-pressure engine was all worn out. I then got two more farther forward with a hand in each water-closet forward, dropping oil through; by this means she kept steady on her course, engines stopped, and sailing 6 knots, while the engineer did his work comfortably. I landed the whole of my cattle alive at Deptford, and never broke any of the cattle-pens.

The use of oil I strongly recommend in an emergency: a small drip is of no use. I used one gallon per hour, and had the watch continually going round attending one bag after another.

The result you know, and I hope it will be of use to shipmasters.

KENNETH DOYLE, Master.

Furness line, SS. Stockholm City,
Boston, Jan. 17.

The Taconic controversy in a nutshell.

In *Science*, No. 153, Prof. N. H. Winchell, in writing under the above head, presents a very timely demurrer against the injustice done to the memory of Professor Emmons in ignoring the name 'Taconic,' and substituting 'Cambrian,' and several other designations, for pre-Potsdam formations other than Archaean.

In referring to recent studies of rocks that have been claimed as part of the Taconic by Emmons, Professor Winchell writes, "Some of the opponents of Emmons, re-enforced lately by active, younger men, revive the fossiliferous character of some of the eastern belts as new matter, adding many interesting and valuable details, and begin again to fire at the old fort long ago abandoned by Emmons, insisting that Emmons is still intrenched there (1872-85)."

I have several reasons for thinking that I have been understood to have taken a stand as part of the re-enforcement, because of my having recently published a paper on the subject mentioned, and entitled "On the occurrence of fossils in the 'Hudson